Coming World Famine?

A scary scenario is beginning to emerge from data about world wheat, rice and grain production figures over the past decade, coupled to the corresponding water tables on the land where much of these grains are raised. As the June 2009 number of the National Geographic brought out, "For most of the past decade, the world has been consuming more food than it has been producing", begging the question, 'What about that hugely successful 'Green Revolution' that is supposedly holding back starvation and producing bumper grain harvests?' We will first look at the father of all 'world population verses food production theorists/scientists', the mathematician Thomas Malthus, who will lay out the groundwork principles for this paper in his simple formula and a brief explanation of what makes it tick.

Thomas Malthus

Thomas Malthus has become widely known for his analysis whereby societal improvements result in population growth which, he states, sooner or later gets checked by famine and widespread mortality. Malthus saw such ideas of endless progress towards a utopian society as vitiated because of the dangers of population growth: "The power of population is indefinitely greater than the power of the earth to produce subsistence for man."

The principle of population

"Between 1798 and 1826 Malthus published six editions of his famous treatise, *An Essay on the Principle of Population,* updating each edition to incorporate new material, address criticisms and to convey changes in his own perspective on the subject…Malthus regarded ideals of future improvement in the lot of humanity with skepticism, considering that throughout history a segment of every human population seemed relegated to poverty. He explained this phenomenon by pointing out that population growth generally preceded expansion of the population's resources, in particular the primary source of food.

Primary theory: the axioms

"The power of population is indefinitely greater than the power in the earth to produce subsistence for man. <u>Population, when unchecked, increases in a geometrical ratio. Subsistence increases only in an arithmetical ratio</u>. A slight acquaintance with numbers will shew the immensity of the first power in comparison with the second."

Proposed solutions

"Malthus argued that population was held within resource limits by two types of checks: *positive* ones, which raised the death rate, and *preventative* ones, which lowered the birth rate. The positive checks included hunger, disease and war; the preventative checks, abortion, birth control, prostitution, postponement of marriage, and celibacy."...

Social theory

Elwell states that Malthus made no specific prediction regarding the future; and that what some interpret as prediction merely constituted Malthus' illustration of the power of geometric/exponential population growth compared to arithmetic growth of food-production. Rather than predicting the future, the *Essay* offers an evolutionary social theory. Eight major points regarding population dynamics appear in the *1798 Essay*:

1. **subsistence severely limits population-level**
2. **when the means of subsistence increases, population increases**
3. **population-pressure stimulates increases in productivity**
4. **increases in productivity stimulate further population growth**
5. **because productivity increases cannot maintain the potential rate of population growth, population requires strong checks to keep parity with the carrying capacity**
6. **individual cost/benefit decisions regarding sex, work, and children determine the expansion or contraction of population and production**
7. **checks will come into operation as population exceeds subsistence-level**
8. **the nature of these checks will have significant effect on the larger sociocultural system---Malthus points specifically to misery, vice, and poverty.**

[taken from http://en.wikipedia.org/wiki/Thomas_Robert_Malthus]

Throughout this article, I want you to pay special attention to Malthus' second, third and 4th point. Simply stated, when the food supply increases, population increases. Population-pressure stimulates increases in productivity. Increases in productivity stimulate further population growth. These three play a key role in explaining why our world population has gone from 2.52 billion people in 1950 to 6.15 billion in 1998. Population right now is estimated at 6.8 billion (http://en.wikipedia.org/wiki/World_Population). Another factor played a key role as well. Right after World War II, and the introduction of DDT and other antibiotics to fight disease, coupled with modern medicine

essentially going worldwide, the death-rates plummeted for the first time in thousands of years. Millions upon millions of children who would have died before child-bearing age grew up to young adult-hood and child-bearing age. That meant multiple millions more people bearing children. This created "population pressure" which demanded an "increase in productivity", or else famine would certainly step in and solve the problem. So DDT and modern medicine from 1945 onward brought the first major population boom from 1945 onward through the 1950s. This population boom brought the Indian subcontinent and S.E. Asia into a period of severe food shortages, leading toward outright famine. Then a man came on the scene who would become instrumental in solving that problem, and increasing productivity. But we are getting a little bit ahead of the story.

Low stockpiles, rising population, and flattening yield growth

What caught my eye though, and made me want to research this subject more thoroughly was the June 2009 number of the National Geographic, and their short, but well researched article titled: "THE END OF PLENTY". Just the first two paragraphs, which I will quote for you here, made me curious enough to want to investigate the subject for myself. Having done an investigative research paper on Global Warming a while earlier (and GW, if indeed it turns out to be true, may exacerbate global food production), my interest was peaked. "Last year the skyrocketing cost of food was a wake-up call for the planet. Between 2005 and the summer of 2008, the price of wheat and corn tripled, and the price of rice climbed five-fold, spurring food riots in nearly two dozen countries and pushing 75 million people into poverty. But unlike previous shortages, this price spike came in a year when the world's farmers reaped a record grain crop. This time, the high prices were a symptom of a larger problem tugging at the strands of our worldwide food web, one that's not going away anytime soon. Simply put*:* ***For most of the past decade [2000 to 2010], the world has been consuming more food than it has been producing. After years of drawing down stockpiles, in 2007 the world saw global carryover stocks fall to 61 days of global consumption, the second lowest on record.*** [emphasis mine throughout this article] "Agricultural productivity growth is only one to two percent a year" warned Joachim von Braun, director general for the International Food Policy Research Institute in Washington, D.C., at the height of the crisis. "This is too low to meet population growth and increased demand." High prices are the ultimate signal that demand is outstripping supply, that there is simply not enough food to go around. Such agflation hits the poorest billion people on the planet the hardest, since they typically spend 50 to 70 percent of their income on food. Even

though prices have fallen with the imploding world economy, they are still near record highs, and ***the underlying problems of low stockpiles, rising population, and flattening yield growth remain."*** [National Geographic Magazine, June 2009, p. 38] Now that's a scary scenario, if ever there was one. But what's behind it, what's driving it, and why is this happening? Didn't the bio-engineered *Green Revolution* solve all those problems? Next we'll look at parts of an article written by Tim Dyson, Professor, London School of Economics.

More about Thomas Malthus

"Malthus's…central argument related to the differential powers of population and agriculture production. Using some of the best-known words in all of social science he stated that "population, when unchecked, increases in a geometrical ratio. Subsistence increases only in an arithmetical ratio. A slight acquaintance with numbers will shew the immensity of the first power in comparison of the second." (Malthus 1798 [1970, 71]. By the word "subsistence" Malthus was referring mainly to the production of *food*. He was well aware that more food could be produced if more land could be brought into cultivation. However, his argument in this passage was based upon the presumption that the supply of land is ultimately fixed [frighteningly, as it pretty much is now in today's world, some 200 years after Malthus wrote this]. So, in modern parlance, he was referring essentially to the form of growth of agricultural *yields* (i.e., output per unit of harvested area). Basically he was suggesting that yield growth tends to be *linear* in form, while drawing upon experience of the infant United States---"where the means of subsistence have been made more ample." (1798 [1970, 74])---under certain conditions populations could grow *geometrically*, at least for limited periods of time. Unfortunately, interpretations of Malthus's statement often overlook the two crucial words "when unchecked." For in fact Malthus believed that most populations were checked in a variety of ways for most of the time. It was only in certain circumstances that a population might temporarily outgrow its food supply and that famine might act as "the last and most dreadful mode by which nature represses a redundant population" (Malthus 1798 [1970, 109]). That said, for much of the time since 1798 Malthus's name has been linked to the idea that the population of the world might outgrow its capacity to produce enough food---so raising the specter of massive famines." [Tim Dyson, "World Food Trends: A Neo-Malthusian Prospect?", p. 438, par. 1-2, p. 439, par. 1-2. (see http://www.amphilsoc.org/sites/default/files/404.pdf for the full article, written in 2001)]

Population growth, 1950 to 1998

Continuing, Tim Dyson says, "The issue of world food production in relation to population growth is undoubtedly important. Since 1950 the human population has increased from about 2.52 billion to about 6.13 billion (United Nations 1998). And despite the falling *rate* of world population growth, especially in parts of Asia and much of sub-Sahara Africa, there is still considerable demographic growth yet to come. By the year 2025, the UN projects, global population will be approaching 8 billion." [I think they underestimated, because as of now, in 2010, the world population is now at 6.8 billion people, way ahead of the projected curve. Don't forget, this paper was written in 2001. But it contains some important points.] "The corresponding "world food problem" too is large and complex. Many of the world's poor subsist on a meager and deficient diet. The Food and Agricultural Organization estimates that today more than eight hundred million people [that's 800,000,000] are undernourished, and virtually all of them live in the developing world (FAO 2000a, 1). FAO also estimates that at the start of the year 2000 thirty-two countries faced food emergencies of various kinds (FAO 2000b, 2). Some writers have suggested that in the early 1980s the world entered a "new era" in which global grain production will increasingly fall behind population growth (e.g., see Brown et al. 1999, chapter 2; Brown and Kane 1995, 21). World cereal yield growth is said to be in trouble; the average world cereal yield has been characterized as experiencing a "dramatic slowdown," an "abrupt deceleration" since 1984 (Brown and Kane 1995, 1000). Looking ahead, some foresee a "demographic trap" in which food production falls in poor countries, death rates rise, and birth rates remain high (e.g. Brown and Kane 1995, 55; King 1999, 1000). It is this kind of doomsday scenario that is referred to in the title of this paper as a *neo*-Malthusian prospect." [Dyson, "World Food Trends: Neo-Malthusian Prospect?", p. 440, par. 1.] That underlined portion I want you to keep in mind when we take a close look at present-day India. Just tuck that line into your mind for now.

What is cereal, and why is it so important?

Let's continue with Dyson for a definition of what cereal is, and how important it is in the worlds' "food chain": "With this as background, the principal purpose of the present paper is to provide a brief overview of world food production trends and prospects. The chief focus will be on cereals. The main cereals are wheat, rice, and coarse grains---which currently represent about 28, 29, and 43 percent of world cereal production respectively. Cereals are the most important food crops. They account for about half of total human caloric intake through their direct consumption (e.g. as cooked rice or bread), and a significantly higher fraction if allowance is made for their indirect intake through the consumption of livestock products (nearly 40 percent of world cereal

production is used to feed livestock)." [Dyson, "World Food Trends: Neo-Malthusian Prospect?", p. 440, par. 2, emphasis mine.] Professor Dyson then for the rest of the paper goes into a detailed breakdown of cereal production statistics by geographic location, North America, Latin America, Europe and the former Soviet Union (FSU), South Asia, Southeast Asia, sub-Sahara, and the Middle East, seven regions in all. If I knew how to make my computer do a circle graph I'd give you the simplified picture. He makes the point that from the mid 1980s to 2001, the two regions of North America and Europe have falling cereal production figures, not due to any farming catastrophe, but simply do to taking a certain percentage of their farmland out of cereal production for economic pricing reasons. So he says falling overall cereal production worldwide has to factor in this agricultural-financial move on the part of North American and European regions. He is correct. But I hope to demonstrate that we are coming into a period where the falling off of those production rates will be due to a far more dangerous trend which is underway right now. For this, we have to understand just what the Green Revolution is, and why its central creator, Norman Borlaug, brought it into being. And I might add, Norman Borlaug's motives for his research and life's work were totally above board and honorable. I wish to use one more quote from Professor Dyson, and then we'll get onto describing the Green Revolution, what it is, who created it, and where it stands right now.

"World Food Prospects Over the Medium Run"

"There is general agreement that the future evolution of world food demand during, say, the next twenty-five years, will be mainly due to population growth. Thus D. Gale Johnson (1999, 5917) has stated that "[t]he primary factor affecting the growth demand for food is population growth." As already noted, the world's population will probably be approaching 8 billion by the year 2025. The bulk of this population growth will happen in the world's poorest and worst-fed regions, particularly South Asia [Indian sub-continent] and sub-Saharan Africa…In the period to 2025 somewhere between 70 and 90 percent of the rise in world cereal demand is likely to be due to demographic growth. ***If population growth is going to be the main element behind the expansion of world food demand over this time horizon, then YIELD growth will be key to the future expansion of the world's food supply. Indeed, yield growth will be absolutely crucial---because the only alternative way of raising food output is by increasing the AREA of harvested land. Yet, particularly in the very populous regions of Asia, there is very little new land that can be brought into cultivation."*** [Tim Dyson, "World Food Trends: A Neo-Malthusian Prospect?", p. 448, par. 3-4 p. 449, par.1. See

http://www.amphilsoc.org/sites/default/files/404.pdf for the full article.]

Famine Stalks India

"During the mid-1960s, [with world population about 3 billion], the Indian subcontinent was at war, and experiencing widespread famine and starvation, even though the U.S. was making emergency shipments of millions of tons of grain, including over one fifth of its total wheat, to the region." [Wikipedia, Norman Borlaug] So population is around 3 billion or just under that during the 1960s. India and Pakistan are in a war with each other. Food production at best, has just barely been able to keep India and Pakistan out of starvation. Now during a war with each other, the region is pushed over the brink into actual starvation. Norman Borlaug has just developed his new strains of high-yield, disease-resistant dwarf-wheat in Mexico. The stage is set for the Green Revolution to go worldwide.

Norman Borlaug, creator of the "Green Revolution"

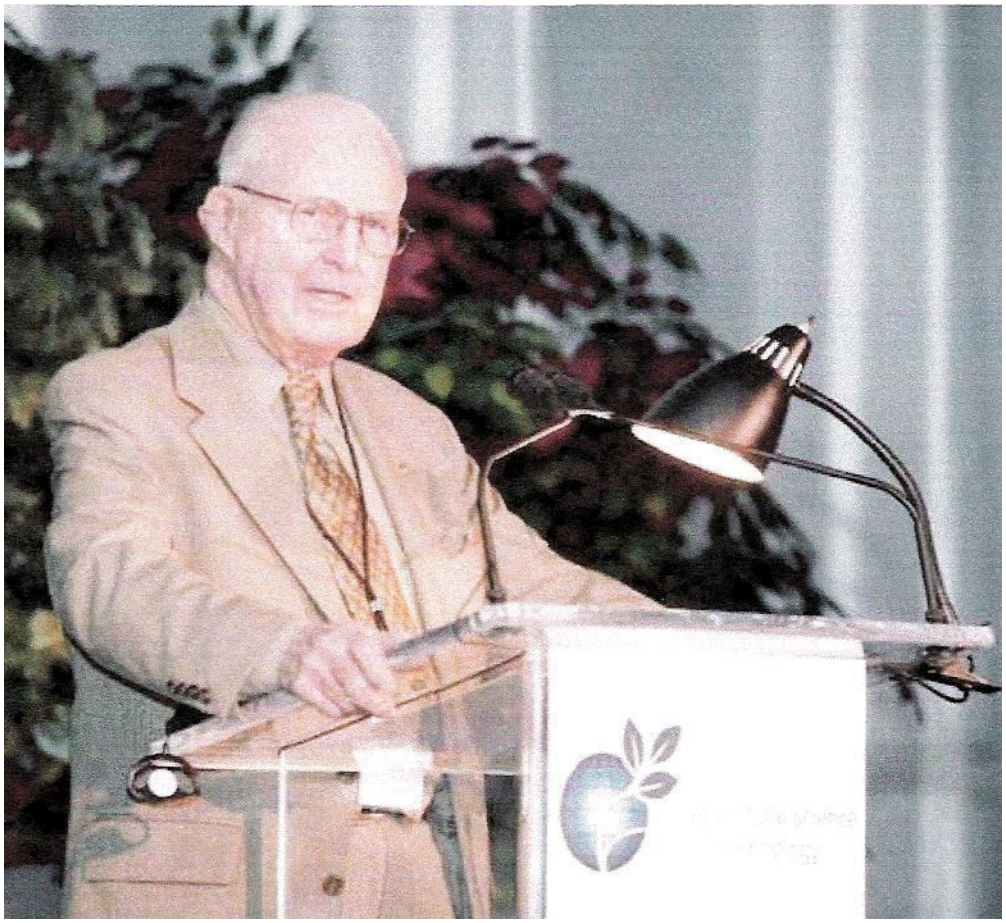
One cannot really understand the 'Green Revolution' without learning about Norman Borlaug, so this section will be about both, because both are pretty much inseparable. Norman Borlaug (March 25, 1914—September 12, 2009) was an American agronomist, humanitarian, and Nobel laureate who has been deemed the father of the Green Revolution. Borlaug was one of only six people to have won the Nobel Peace Prize, the Presidential Medal of Freedom and the Congressional Gold Medal. He was also a recipient of the Padma Vibhushan, India's second highest civilian honour. Borlaug received his Ph.D. in plant pathology and genetics from the University of Minnesota in 1942. He took up an agricultural research position in Mexico, where he developed semi-dwarf, high-yield, disease-resistant wheat varieties."

Wheat research in Mexico, birth of the 'Green Revolution'

"The Cooperative Wheat Research Production Program, a joint venture by the Rockefeller Foundation and the Mexican Ministry of Agriculture, involved research in genetics, plant breeding, plant pathology, entomology, soil science, and cereal technology. The goal of the project was to boost wheat production in Mexico, which at this time was importing a large portion of its grain…Borlaug would remain with the project for sixteen years. During this time, he bred a series of remarkably successful high-yield, disease resistant, semi-dwarf wheat… During the mid-20th century, Borlaug led the introduction of these high-yielding varieties combined with modern agricultural production

techniques to Mexico, Pakistan, and India. As a result, Mexico became a net exporter of wheat by 1963. Between 1965 and 1970, wheat yields nearly doubled in Pakistan and India, greatly improving the food security in those nations. These collective increases in yield have been labeled the Green Revolution, and Borlaug is often credited with saving over a billion people worldwide from starvation." During this war between India and Pakistan "the Indian and Pakistani bureaucracies and the region's cultural opposition to new agricultural techniques initially prevented Borlaug from fulfilling his desire to immediately plant the new wheat strains there. By the summer of 1965, the famine became so acute that the governments stepped in and allowed his projects to go forward. Biologist Paul R. Ehrlich wrote in his 1968 bestseller *The Population Bomb*, "The battle to feed all of humanity if over…In the 1970s and 1980s hundreds of millions of people will starve to death in spite of any crash programs embarked upon now." Ehrlich said, "I have yet to meet anyone familiar with the situation who thinks India will be self-sufficient in food by 1971," and "India couldn't possibly feed two hundred million more people by 1980." In 1965 after extensive testing, Borlaug's team, under Anderson, began its effort by importing about 450 tons of Lerma Rojo 64 and Sonora 64 semi-dwarf seed varieties: 250 tons went to Pakistan and 200 to India…The initial yields of Borlaug's crops were higher than any ever harvested in South Asia. The countries subsequently committed to importing large quantities of both Lerma Rojo 64 and Sonora 64 varieties. In 1966, India imported 18,000 tons---the largest purchase and import of any seed in the world at that time [this seed was for planting, by the way, not eating]. In 1967 Pakistan imported 42,000 tons, and Turkey 21,000 tons. Pakistan's import, planted on 1.5 million acres (6,100 sq. km), produced enough wheat to seed the entire nation's wheatland the following year. By 1968, when Ehrlich's book was released, William Gaud of the United States Agency for International Development was calling Borlaug's work a "Green Revolution". High yields led to a shortage of various utilities---labor to harvest the crops, bullock carts to haul it to the threshing floor, jute bags, trucks, rail cars, and grain storage facilities. Some local governments were forced to close school buildings temporarily to use them for grain storage. In Pakistan, wheat yields nearly doubled, from 4.6 million tons in 1965 to 7.3 million tons in 1970; Pakistan was self-sufficient in wheat production by 1968. Yields were over 21 million tons by 2000. In India, yields increased from 12.3 million tons in 1965 to 20.1 million tons in 1970. By 1974, India was self-sufficient in the production of all cereals. By 2000, India was harvesting a record 76.4 million tons (2.81 billion bushels) of wheat. Since the 1960s, food production in both nations has increased faster than the rate of population growth…The use of these wheat varieties has also had a substantial effect on production in six Latin American countries, six countries in the Near and Middle East, and several others in Africa…Borlaug's work with wheat led to the development of high-yield

semi-dwarf *indica* and *japonica* rice cultivars at the International Rice Research Institute, started by the Ford and Rockefeller Foundations, and at China's Hunan Rice Research Institute. Borlaug's colleagues at the Consultative Group on International Agricultural Research also developed and introduced a high-yield variety of rice throughout Asia. Land devoted to the semi-dwarf wheat and rice varieties in Asia expanded from 200 acres (0.8 sq. km) in 1965 to over 40 million acres (160,000 sq. km) in 1970. In 1970, this land accounted for over 10% of the more productive cereal land in Asia." [selected paragraphs from "Norman Borlaug," Wikipedia, http://en.wikipedia.org/wiki/Norman_Borlaug] Let's take a closer look at what fuels the *Green Revolution*, and fuel is a good word for it.



What Fuels the Green Revolution?

"The projects within the Green Revolution spread technologies that had already existed, but had not been widely used outside industrialized nations. These technologies included pesticides, irrigation projects, synthetic nitrogen fertilizer and improved crop varieties developed through the conventional, science-based methods available at the time.

The novel technological development of the Green Revolution was the production of novel wheat cultivars. [**Cultivar**, "A **cultivar** is a cultivated variety of a plant that has been deliberately selected for specific desirable characteristics (such as the colour and form of the flower, yield of the crop, disease resistance etc.) When propagated correctly the plants of a particular cultivar retain their special characteristics." See http://en.wikipedia.org/wiki/Cultivar] Agronomists bred cultivars of maize, wheat, and rice that are generally referred to as HYVs or "high-yielding varieties". HYVs have higher nitrogen-absorbing potential than other varieties. Since cereals that absorbed extra nitrogen would typically lodge, or fall over before harvest, semi-dwarfing genes were bred into their genomes. A Japanese dwarf wheat cultivar (Norin 10 wheat), which was sent to Washington, D.C. by Cecil Salmon, was instrumental in developing Green Revolution wheat cultivars. IR8, the first widely implemented HYV rice to be developed by IRRI, was created through a cross between an Indonesian variety named "Peta" and a Chinese variety named "Dee-geo-woo-gen."…**HYVs significantly outperform traditional varieties *in the presence of adequate irrigation, pesticides, and fertilizers. In the absence of these inputs, traditional varieties may outperform HYVs."*** Sooo, if something were to happen to either the ability to supply enough water, insecticides or nitrogen-rich petroleum-based fertilizer, a farmer having no other seed but the HYVs, say from his previous harvest, could be in a world of hurt, due to a very poor harvest compared to even the normal cultivars, let alone what's a normal harvest for HYVs with sufficient water, pesticides and nitrate fertilizers. I just wanted to make that distinction, for it applies to the apparently changing set of circumstances overtaking regions that are utilizing Green Revolution cultivars, and methods of supporting them. "Therefore several authors have challenged the apparent superiority of HYVs not only to the traditional varieties alone, but by contrasting the monocultural system associated with HYVs with the polycultural system associated with the traditional ones."

"Production increases"

"Cereal production more than doubled in developing nations between 1961-1985. Yields of rice, maize, and wheat increased steadily during that period. The production increases can be attributed roughly equally to irrigation, fertilizer [fossil based, that is] and seed development, at least in the case of Asian rice. While agricultural output increased as a result of the Green Revolution, the energy input to produce a crop has increased faster…Green Revolution techniques also heavily rely on chemical fertilizers, pesticides and herbicides, some of which [most of which, in reality] must be developed from fossil fuels, making agriculture increasing reliant on petroleum products. Proponents of the Peak Oil theory fear that a future decline in oil and gas production would lead to a

decline in food production or even a Malthusian catastrophe." [http://en.wikipedia.org/wiki/Green_Revolution] So we can see some built-in weaknesses of the Green Revolution. It relies heavily on petro-chemicals, from nitrate fertilizers, insecticides and herbicides. It also relies heavily on irrigation, which we will come to see, relies heavily on electricity, pumps and ground-wells, tapping into the local ground-water tables and aquifers.

The Green Revolution has allowed for the comfortable rise in world population---from roughly 2 billion to 6.8 billion people

"The world population has grown by about four billion since the beginning of the Green Revolution and many believe that, without the Revolution, there would have been greater famine and malnutrition. India saw annual wheat production rise from 10 million tons in the 1960s to 73 million in 2006. The average person in the developing world consumes roughly 25% more calories per day now than before the Green Revolution. Between 1950 and 1998, as the Green Revolution transformed agriculture around the globe, world grain production increased by over 250%. The production increases fostered by the Green Revolution are often credited with having helped to avoid widespread famine, and for feeding billions of people." [ibid.] The Green Revolution has allowed for the comfortable rise in world population from roughly 2 billion people to 6.8 billion people, as of February 27, 2010.

Criticisms

"Malthusian criticism: Some criticisms generally involve some variation of the Malthusian principle of population. Such concerns often revolve around the idea that the Green Revolution is unsustainable, and argue that humanity is now in a state of overpopulation with regards to the sustainable carrying capacity and ecological demands on the Earth." [ibid] As we shall come to see, these are very justified concerns. "Although 36 million die each year as a direct result of hunger and poor nutrition, Malthus' more extreme predictions have frequently failed to materialize. In 1798 Thomas Malthus made his prediction of impending famine. The world's population had doubled by 1923, and doubled again by 1973 without fulfilling Malthus' prediction. Malthusian Paul R. Ehrlich, in his 1968 book *The Population Bomb*, said that "India couldn't possibly feed two million more people by 1980" and "Hundreds of millions of people will starve to death in spite of any crash programs." Ehrlich's warnings failed to materialize when India became self-sustaining in cereal production in 1974 (six years later) as a result of the introduction of Norman Borlaug's dwarf wheat varieties." [ibid] So, do we throw the work and theorems of Thomas Malthus in the trashcan?

No, his observations on geometric population growth verses mathematical growth of foodstuffs are accurate enough, and so are those 8 points I quoted earlier on, taken from his works. But up to now there's always been an abundance of new lands that could be brought under cultivation, and also we hadn't artificially overextended ourselves using agriculture based on fossil fuels, and heavy irrigation via means of modern power-sources, which have the ability to pump groundwater down beyond recovery. Don't throw Thomas Malthus away yet.

Flat-lining and Environmental Impact of the Green Revolution

Environmental impacts are not always evident when some new form of agriculture is put into widespread practice. It takes years to view the pro's and con's of an agricultural system accurately, as to its pro's and con's. While the pro's became evident shortly after the widespread use of Norman Borlaug's seed cultivars, along with all it's resultant irrigation, use of nitrate fertilizers, pesticides and herbicides all manufactured from fossil fuels, the negative side effects often take years, whole decades to manifest themselves. And manifest themselves they have, with a vengeance. We will look at one item at a time.

Pesticides: pesticides and cancer

"In the Philippines the introduction of heavy pesticides to rice production, in the early part of the green revolution, poisoned and killed off fish and weedy green vegetables that traditionally coexisted in rice paddies. These were nutritious food sources for many poor Filipino farmers prior to the introduction of pesticides, further impacting the diets of locals…Green Revolution agriculture relies on extensive use of pesticides, which are necessary to limit the high levels of pest damage that inevitably occur in monocropping---the practice of producing or growing one single crop over a wide area…The consumption of the chemicals and pesticides used to kill pests by humans in some cases may be increasing the likelihood of cancer in some of the rural villages using them. [Some?] Poor farming practices including noncompliance to usage of masks and over-usage of the chemicals by un-educated farmers in poor countries compound this situation. Long term exposure to pesticides such as organochlorines, creosote, and sulfallate have been correlated with higher cancer rates and organchlorines DDT, chlordane, and lindane as tumor promoters in animals. Contradictory epidemiologic studies in humans have linked phenoxy acid herbicides or contaminants in them with soft tissue sarcoma (STS) and malignant lymphoma, organochlorine insecticides with STS, non-Hodgkins's lymphoma (NHL), leukemia, and, less consistently, with cancers of the lung and breast,

organophosphorus compounds with NHL and leukemia, and triazine herbicides with ovarian cancer." [ibid]

"Punjab case: The Indian state of Punjab pioneered green revolution among the other states transforming India into a food-surplus country. The state is witnessing serious consequences of intensive farming using chemicals and pesticide. A comprehensive study conducted by Post Graduate Institute of Medical Education and Research (PGIMER) has underlined the direct relationship between indiscriminate use of these chemicals and increased incidence of cancer in the region. Increase in the number of cancer cases has been reported in several villages including Jhaviwala, Koharwala, Puckka, Bhimawali, and Khara." [ibid. Green Revolution, Wikipedia] We'll let the National Geographic take up where this left off. "Walking through the narrow dirt lanes past the pyramids of dried cow dung, Singh introduces Amarjeet Kaur, a slender 40-year-old…She was diagnosed with breast cancer. Her surgery, she says, wasn't nearly as painful as losing her seven-year-old grandson to "blood cancer," or leukemia. Jagdev Singh is a sweet-faced 14-year-old boy whose spine is slowly deteriorating…"The doctors say he will not live so see 20," says Bhola Singh. There's no proof these cancers were caused by pesticides. But researchers have found pesticides in the Punjabi farmers blood, their water table, their vegetables, even their wives' breast milk. So many people take the train from the Malwa region to the cancer hospital in Bikaner that it's now called the Cancer Express. The government is concerned enough to spend millions on reverse-osmosis water-treatment plants for the worst effected villages. If that weren't worrisome enough, the high cost of fertilizers and pesticides has plunged many Punjabi farmers into debt. One study found more than 1,400 cases of farmer suicides in 93 villages between 1988 and 2006. Some groups put the total for the states as high as 40,000 to 60,000 suicides over that period. Many drank pesticides or hung themselves in their fields. "The green revolution has brought us only downfall," says Jarnail Singh, a retired school-teacher in Jaijal village. "It ruined our soil, our environment, our water table. Used to be we had fairs in villages where people would come together and have fun. Now we gather in medical centers. The government has sacrificed the people of Punjab for grain."" [National Geographic, June 2009 number, article "THE END OF PLENTY", p. 46, col.2, par. 4, p. 47, col.1, par 1-3, col.2, par.1] Wow. Don't know what to say beyond that. That kind of makes it up close and personal. But there's more.

Water, irrigation

"Industrialized agriculture with its high yield varieties are extremely water intensive. In the US, agriculture consumes 85% of all fresh water resources. For example, the Southwest uses 36% of the nation's water

while at the same time only receiving 6% of the country's rainfall. Only 60% of the water used for irrigation comes from surface water supplies. The other 40% comes from underground aquifers that are being used up in a way similar to topsoil that makes the aquifers, as Pfeiffer says, "for all intents and purposes non renewable resources." The Ogallala Aquifer is essential to a huge portion of central and southwest plain states, but has been at annual overdrafts of 130-160% in excess of replacement. **This irrigation source for America's bread basket will become unproductive in another 30 years or so.** Likewise, rivers are drying up at an alarming rate. In 1997, the lower parts of China's Yellow River were dry for a record 226 days. Over the past ten years, it has gone dry an average of 70 days a year. Famous lifelines such as the Nile and Ganges along with countless other rivers are sharing in the same fate. The Aral Sea has lost half its area and two-thirds its volume due to river diversion for cotton production. Also the water quality is being compromised. In the Aral Sea, water salinization has wiped out all native fish, leaving an economy even more dependent on the agricultural model that originated the problem. Fish are disappearing through another form of agricultural run off as well. When nitrogen-intensive fertilizers wash into waterways it results in an explosion of algae and other microorganisms that lead to oxygen depletion resulting in "dead zones", killing off fish and other creatures." [Wikipedia, "Green Revolution"] The New York Times ran an article about population outstripping agriculture, parts of which I will quote, "JALANDHAR, India---With the right technology and policies, India could help feed the world. Instead, it can barely feed itself. India's supply of arable land is second only to that of the United States, its economy is one of the fastest growing in the world, and its industrial innovation is legendary. But when it comes to agriculture, its output lags far behind potential. For some staples, India must turn to already stretched international markets, exacerbating a global food crisis. It was not supposed to be this way. Forty years ago, a giant development effort known as the Green Revolution drove hunger from an India synonymous with famine and want. Now, after decades of neglect, this country is growing faster than its ability to produce more rice and wheat. The problem has grown so dire that Prime Minister Manmohan Singh has called for a Second Green Revolution "so that the specter of food shortages is banished from the horizon once again."...Experts blame the agriculture slowdown on a variety of factors. The Green Revolution introduced high-yielding varieties of rice and wheat, expanded the use of irrigation, pesticides and fertilizers [petro-chemically manufactured high nitrate fertilizers], and transformed the northwestern plains into India's breadbasket. Between 1968 and 1998, the production of cereals in India more than doubled. But since the 1980s, the government has not expanded irrigation and access to loans for farmers, or to advance agricultural research. **Groundwater has been depleted at alarming rates...**Family farms have

shrunk in size and quantity, and a few years ago mounting debt began to drive some farmers to suicide. [some?] Now many find it more profitable to sell their land to developers of industrial buildings…By the 1980s, government investment in canals fed by rivers had tapered off, and wells become the principal source of irrigation, helped by a shortsighted government supplying free electricity to pump water. Here in Punjab, more than three-fourths of the districts extract more groundwater than is replenished by nature. And he [Mr. Chawla, a local farmer in Punjab] sees more trouble on the way. The summers are hotter than he remembers. The rains are more fickle. Last summer, he wanted to ease out of growing rice, a water-intensive crop." Mr. Chawla also stated in the article, and this fact, if verifiable is incredible, **"the water table under his land has sunk by 100 feet over the past three decades as he and other farmers irrigated their fields."** [New York Times article "In Fertile India, Growth Outstrips Agriculture", see http://www.nytimes.com/2008/06/22/business/22indiafood.html?_r=2 for the full article.]

Amazing GRACE satellites measure Earth's watertables

What follows are some excerpts from a downright scary article, taken from ***ScienceDaily***'s article **"Satellites Unlock Secret to Northern India's Vanishing Water"** "Using satellite data, UC Irvine and NASA hydrologists have found that groundwater beneath northern India has been receding by as much as 1 foot per year over the past decade---and they believe human consumption is almost entirely to blame. More than 109 cubic kilometers (26 cubic miles) of groundwater disappeared from the region's aquifers between 2002 and 2008---double the capacity of India's largest surface-water reservoir…People are pumping northern India's underground water, mostly to irrigate cropland, faster than natural processes can replenish it, said Jay Famiglietti and Isabella Velicogna, UCI Earth system scientists, and Matt Rodell of NASA's Goddard Space Flight Center. "If measures are not soon taken to ensure sustainable groundwater usage, consequences for the 114 million residents of the region may include a collapse of agricultural output, severe shortages of potable water, conflict and suffering," said Rodell, lead author of the study and former doctoral student of Famiglietti's at the University of Texas, Austin…"Groundwater mining---that is when withdrawals exceed replenishment rates---is a rapidly growing problem in many of the world's large aquifers," Famiglietti said. "Since groundwater provides nearly 80 percent of the water required for irrigated agriculture, diminishing groundwater reserves pose a serious threat to global food security."" (See hypertext link below for the full article.) [University of California—Irvine (2008, August 19). **Satellites Unlock Secret To Northern India's Vanishing Water**. *ScienceDaily*. Retrieved February 25, 2010, from

http://www.sciencedaily.com/releases/2009/08/090812143938.htm]
Backing that article up is this one from SCIENTIFIC AMERICAN, August 12, 2009, **"Is Northwestern India's Breadbasket Running Out of Water?", by David Biello. "A new study using satellite data suggests the region is using more groundwater than is being replenished by rainfall.** The fields of barley, rice and wheat that feed much of India are running out of water, according to a new study based on satellite data and published online in *Nature* today. The heartland of last century's Green Revolution lost 109 cubic kilometers of water from its Indus River plain aquifer between August 2002 and October 2008. (*Scientific American* is part of Nature Publishing Group.) "by our estimates, the water table is declining at a rate of one foot per year averaged over the Indian states of Rajasthan, Punjab and Haryana, including the national capital territory of Delhi," an area in northwestern India that covers more than 438,000 square kilometers, says NASA hydrologist Matthew Rodell, lead author of the paper. "We are not able to estimate the total amount of groundwater in storage [in the aquifer], so we can't say when it will be gone, but residents are already feeling the effects and it will only become worse." The consequences include wells that run dry, water shortages in India's capital and, potentially, a decline in yields from agriculture. India's Ministry of Water Resources has long suggested that tapping the aquifer for irrigation was exceeding the limited regional rainfall that replenishes its water, and the World Bank has warned that the country faces a water crisis. On a yearly basis, nearly 63 cubic kilometers of water are drawn from the aquifer, whereas the Indian government estimates that roughly 45 cubic kilometers of water recharge the aquifer annually. The scientists relied on data from the pair of GRACE satellites---NASA's Gravity Recovery and Climate Experiment orbiters launched in 2002---that measure subtle changes in Earth's gravitational field, which are often the result of shifting water, whether on the surface or deep beneath it. In addition to large-scale water losses detected in Greenland and other polar regions by the GRACE satellites, northwestern India stands out as another area of rapid water loss. "Basically, it is like we weigh Earth every month and we look at the changes," explains geophysicist Isabella Velicogna of the University of California, Irvine, part of the research team. The primary reason for such groundwater depletion is irrigation, which has fed the Green Revolution that transformed cereal production in the region and helped a growing population that has reached 114 million people. [That is, 114 million people in the Indian states of Rajasthan, Punjab and Haryana.] Between 1970 and 1999 irrigated fields in India tripled in overall extent to cover more than 33 million hectares. ***That irrigation now looks unsustainable:...***" [SCIENTIFIC AMERICAN, August 12, 2009, online article, p. 1, par. 1-5. See http://www.scientificamerican.com/article.cfm?id=is-india-running-out-of-water&print=true to read the whole article.] What exactly is GRACE?

From the previous *ScienceDaily* article we get a brief description. "GRACE detects differences in gravity brought about by fluctuations in water mass, including water below the earth's surface. As the satellites orbit [two of them] 300 miles above Earth, their positions change---relative to each other---in response to variations in the pull of gravity. They fly about 137 miles apart, and microwave ranging systems measure every microscopic variance in the distance between the two. "With GRACE, we can monitor water storage changes everywhere in the world from our desk," said Velicogna, also with NASA's Jet Propulsion Laboratory. "The satellites allow us to observe how water storage evolves from one month to the next in critical areas of the world."" [*ScienceDaily*, online article at http://www.sciencedaily.com/releases/2009/08/090812143938.htm]
The Scientific American article continues to describe the problem. "The water contained in the Indus River plain aquifer, once pumped, is lost to the region via evaporation from irrigation or transpiration from irrigated plants. And GRACE has detected similar depletion in the U.S., as well, including the Ogallala Aquifer under the western plains and the groundwater in the California's Central Valley. "Groundwater resources are being rapidly depleted in many regions of the world," says U.C. Irvine hydrologist James Famiglietti, another team member. "These signals of groundwater loss, in particular in the Central Valley [of California], are very strong." As population growth continues and food production increases, however, demand for groundwater will only increase," Famiglietti warns. [ibid, SCIENTIFIC AMERICAN online article]

Columbia University weighs in

Next we'll look at some excerpts taken from an online article published by the COLUMBIA WATER CENTER, THE EARTH INSTITUTE AT COLUMBIA UNIVERSITY. The article is titled **"Columbia Conference on Water Security in India"**, written on April 15-19, 2009. "***The Challenge*** Of all major nations, India faces the most serious resource and environmental challenge in the modern era. India, with nearly a sixth of all people in the world, most still mired in poverty, faces an unprecedented crisis in the next two decades…Not surprisingly, aquifer depletion and inefficient water use are now endemic. Uncertainty as to what climate change portends for water supply is a concern, but the needs of a still growing population for food will likely determine the shape of the water crisis in the country. The World Bank warns of a *Turbulent Water Future for India,* absent dramatic coordinated government investments in water infrastructure, governance and agricultural productivity…The utilization of high yield crop varieties, as well as a host of government sponsored subsidies for agriculture, has contributed to India's successful food grain economy. The subsidies were targeted at making the two variable inputs, water for irrigation and

fertilizer, widely available at affordable prices. As a result, almost half of the total agricultural land in India is now irrigated…Agriculture accounts for 80-90% of total water withdrawals in India. Irrigated agriculture yields dramatically higher yields compared to rainfed agriculture. Consequently, irrigated acreage has nearly tripled since 1950. Over the last 60 years, India's food grain economy has become one of the largest in the world and has made the country self-reliant in its major food staples. Annual food grain production increased from 51 million tons in the early fifties [1950s] to 206 million tons at the turn of the century [i.e. year 2000]. Rice and wheat are the two dominant crops in terms of caloric intake. As of 2002, the rice cropping area of India was roughly 30 percent of the global sown rice area. Due to this volume and because, on average, more than 90 percent of rice production is from flooded paddy fields, rice agriculture is the major water consumer in India. India is now the world's largest user of groundwater for irrigation, and many areas suffer from progressive groundwater depletion raising the concern that the practice is not sustainable. The shift to groundwater irrigation is mainly due to the fact that rains in India are seasonal, intense and infrequent. Reservoir and canal systems are plagued by issues of access and maintenance. On the other hand, there is direct access to groundwater due to personal wells, and because subsidized or free electricity for running motored wells and tubewells is available, it is estimated that groundwater irrigation in the country sustains 27 million ha [hectares?] of farmland, or approximately 60 percent of the total irrigated area, and that total groundwater extraction is as high as 200 sq. km." [COLUMBIA WATER CENTER, THE EARTH INSTITUTE AT COLUMBIA UNIVERSITY, article "Columbia Conference on Water Security in India, p. 1, par. 1-3, selected portions, p. 2, par. 1-2 selected portions. To read the whole article, log onto: http://water.columbia.edu/sitefiles/file/India%20Conference/India%20Conference.pdf]

So where are we now?

So now we see that Norman Borlaug's *"Green Revolution"* essentially staved off starvation on the Indian subcontinent, and also helped two major regions of world population, the Indian subcontinent and that of Southeast Asia and China become comfortable in food production of essential cereal grains. This allowed for the relatively painless population growth from the 1950s figure of 2.52 billion people to where it is currently, at a whopping 6.8 billion people. Remember what Thomas Malthus said? Three of his theorems come into play here. We haven't escaped Malthus after all, and this is scary.

2. when the means of subsistence increases, population increases
3. population-pressure stimulates increased productivity

4. increases in productivity stimulate further population growth

Those three theorems or laws, were essentially at work from 1950 to the present. Normal Borlaug's *Green Revolution* has caught mankind in a sort of Malthusian trap that we can't really get out of. The Indian subcontinent and Southeast Asia having now experienced an overabundance of food, at least compared to what they were used to (i.e. always being on the brink of starvation), the population within those two very populous regions mushroomed. The same has happened in the Latin American countries, starting with Mexico. People, experts, have said Malthus was passé, that his dire predictions would never occur in a modern world, filled with bio-engineered miracles on the farmlands of the world. We have just seen that the Green Revolution has nasty side-effects, and based on what we've read, the Green Revolution should be flat-lining as far as production increases in cereal grains. Do we see this happening? In the June 2009 National Geographic article THE END OF PLENTY, it says this "Today though, the miracle of the green revolution is over in Punjab: Yield growth has essentially flattened since the mid-1990s. Over irrigation has led to steep drops in the water table, now tapped by 1.3 million tube-wells, while thousands of hectares of productive land have been lost to salinization and waterlogged soils. Forty years of intensive irrigation, fertilization, and pesticides have not been kind to the loamy gray fields of Punjab. Nor, in some cases, to the people themselves." [June 2009 number National Geographic, p. 46, col. 2. Par. 2] Again we find India's population is growing faster than its ability to produce rice and wheat, almost the identical situation Norman Borlaug found on the Indian subcontinent in the 1950s. Malthus' theorems so far are right on the mark.

Chart below shows the flat-lining of wheat yields starting in the mid-1990s

World Population

Next, let's take a peek at current world population figures to see where the greatest number of people live on this planet, and why the focus has always been on the Indian subcontinent and SE Asia. Was Paul Ehrlich right, is the world a ticking *population-bomb?* For Paul Ehrlich was the last real neo-Malthusian agronomist of the 20th century, along with William and Paul Paddock, who co-write *Famine 1975!* Their book gave an excellent scenario, by the way, of what will happen should the Malthus food production curve line cross the world population line. You just have to erase the predictive dates that are written in *"Famine 1975!"*. Then you find a pretty sound scenario. It's worth reading, just to see what would start to occur around the world. So now for a population

update. "As of 27 February 2010, the Earth's human population is estimated by the United States Census Bureau to be 6,805,200,000. The United Nations estimated the world's population to be 6,800,000,000 in 2009…The fastest rates of world population growth (above 1.8%) were seen briefly during the 1950s then for a longer period during the 1960s and 1970s. The 2008 rate of growth has almost halved since its peak of 2.2% per year, which was reached in 1963. World births have leveled off at about 134 million per year, since their peak at 163 million in the late 1990s, and are expected to remain constant. However, deaths are only around fifty-seven million per year…Because births outnumber deaths, the world's population is expected to reach nine billion in 2040.

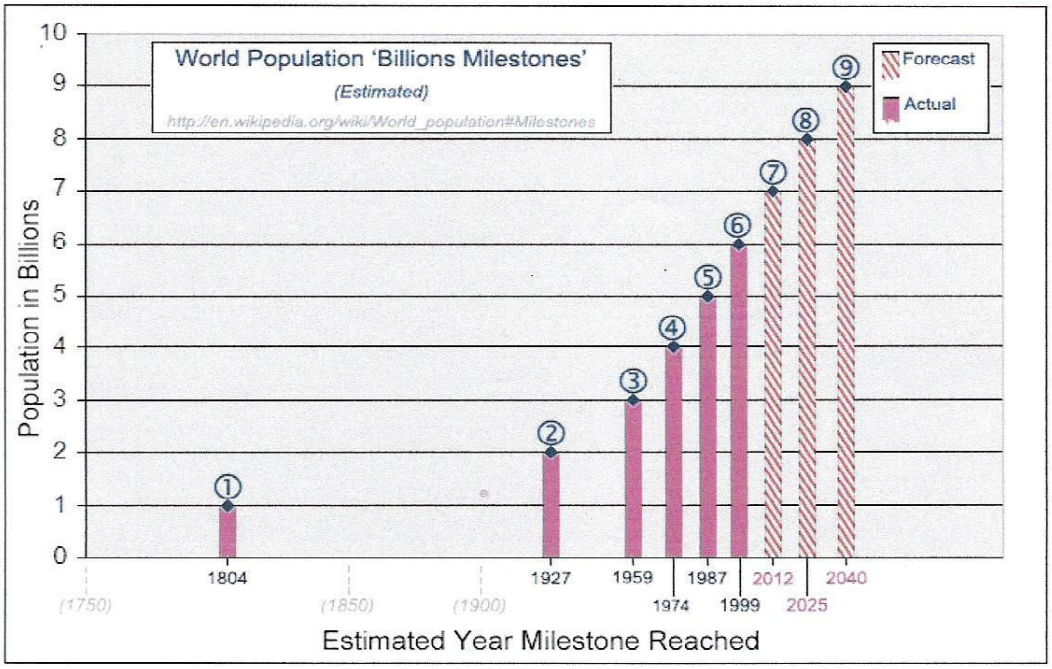
World populations by region (2008):

World:	6.707 billion
Africa:	973 million
Asia:	4.054 billion
Europe:	732 million
Latin America and the Caribbean:	577 million
North America:	337 million
Oceania:	34 million

By percentage (2008):

World:	100%
Africa:	14.5%
Asia:	60.4%
Europe:	10.9%
Latin America and the Caribbean:	8.6%
North America:	5%
Oceania:	0.5%

[taken from http://en.wikipedia.org/wiki/World_Population]



Above chart shows that by 2012 world population will be at 7 billion people

Norman Borlaug dismissed certain claims of critics, but did take other concerns seriously. He stated that his work has been "a change in the right direction, but it has not transformed the world into a Utopia." Of environmental lobbyists he stated: "Some of the environmental lobbyists of the Western nations are the salt of the earth, but many of them are elitists. They've never experienced the physical sensation of hunger. They do their lobbying from comfortable office suites in Washington or Brussels…If they lived just one month amid the misery of the developing world, as I have for fifty years, they'd be crying out for tractors and fertilizer and irrigation canals and be outraged that fashionable elitists

back home were trying to deny them these things." [Wikipedia.org, "The Green Revolution"] Norman Borlaug's humanity without taking Thomas Malthus' equations into proper consideration may have led the world into this precarious balance between sustaining food production increases and rapidly expanding population as a direct result of increased food production. It bought the world time, held Malthus at bay, but only for a short space of time---allowing the coming Malthusian catastrophe to be even greater than it would have been. Japan, right after World War II, realizing it could not expand the available land their people lived on, took Thomas Malthus seriously in one of his solutions, birth control, limiting the number of children each couple could have. It worked. China, with less success, has tried the same thing. The earth is finite. The amount of arable land is finite. The amount of groundwater on any given continent is finite. Just like your checking account is finite. If you regularly exceed withdrawals in excess of deposits, eventually your checks will start to bounce. When mother nature's checks start to bounce, it's not going to be pretty. Do we beat up Normal Borlaug? Far from it, he was a caring humanitarian, and a brilliant agricultural scientist who tried to use his gifts to help a suffering mankind.

Does the Bible have anything to say about Worldwide Famine?

Interestingly enough, the Bible does have something to say about a coming worldwide famine that will be so great that an estimated 25 percent of the world's population is going to die from famine, and resultant disease epidemics. The Olivet Prophecy of Jesus, as recorded in Matthew 24, Mark 13 and Luke 21 all predict this, and if tied into the Book of Revelation, this equates to the third and fourth symbolic Horsemen of the Apocalypse. Now the second horse, if you read through Revelation 6, is war, culminating in World War. Well, with the earth sitting in such a precarious position of overpopulation compared to food production barely able to keep pace, a world war would push the world into crossing Thomas Malthus' two critical lines, population verses food production. Interestingly enough, I have just put together a commentary on the Book of Revelation which covers all of this. So there is no need to be redundant in copying out all that information. My fingers are getting tired, typing all of this, and my brain needs a rest. So log onto **http://www.unityinchrist.com/revelation/revelation4-10.html** and read it for yourself. It's a fascinating study, and very timely, considering the age we live in, nearing the end of the Age of Man, and the beginning of the Millennial Age of our Lord's soon-coming Kingdom of God. That kingdom, when established, will permanently solve the world's food verses population problem, and not by limiting world populations, which will virtually explode in that age to come. Something's wrong with the

way mankind does things, we always seem to be painting ourselves into a corner. Maybe God can show us through his Son how to do it right, when he returns to earth.

Related links:

Coming World Famine and World War:
http://www.unityinchrist.com/revelation/revelation4-10.html

Coming Kingdom of God to rule the world:
http://www.unityinchrist.com/kingdomofgod/mkg1.htm
http://www.unityinchrist.com/kingdomofgod/isaiah/isaiah1.htm

Is Global Warming for real? Here are the facts, you decide:
http://www.unityinchrist.com/warming/warming1.htm

Ambassador College Big Sandy agricultural booklet, *World Crisis in Agriculture*, now available online:

Important quotes from Norman Borlaug in 1995:
http://cgca.net/serf-publishing/agcrisis.htm
Chapter 1:
http://cgca.net/serf-publishing/landofplenty.htm
Chapter 2:
http://cgca.net/serf-publishing/qualityandhealth.htm
Chapter 3:
http://cgca.net/serf-publishing/economiccrisis.htm
Chapter 4:
http://cgca.net/serf-publishing/govcrisis.htm

A note about the *Ambassador College* booklet *"World Crisis in Agriculture."* The Worldwide Church of God ran this college, and it was at the cutting edge of what has become known as modern *organic farming*. As a matter of fact, this Ambassador College started the whole environmental movement in the mid-1960s, as well as pioneering in *organic farming*. But they never ever received any credit for all of this in the media, because they were considered a *cult legalistic religion*. Where did the Worldwide Church of God come from? See http://www.unityinchrist.com/history/historycog1.htm.